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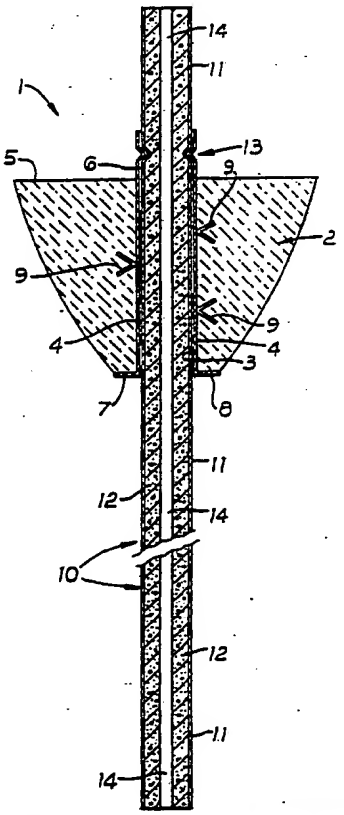
(57) Abstract

A metallurgical dart (1) comprises an enlarged refractory head (2) having a top (5), a bottom (7), and a central through hole (3) extending from top to bottom of the head (2) and lined with a metallic sleeve (4), with a portion (6) of the lining sleeve (4) projecting beyond the top (5) and/or bottom (7) of the head (2); an elongate tail (10) of refractory material (12) with an external and/or internal metallic element (11, 14) and of external diameter (D2) slightly less than the internal diameter (D1) of the lining sleeve (4), such that the tail (10) can pass, as a close fit, through the lining sleeve (4) of the head (2); and at least one crimped or other joint (13, 13A) between the, or a, metallic element (11, 14) of the tail (10) and the projecting portion (6) of the lining sleeve (4), to fix the head (2) and tail (10) together.



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SLAG RETAINING DEVICE

This invention relates to a so-called dart, as used in the metallurgical industry in the tapping of furnaces to control, or preclude, slag exit and hence slag contamination of the steel etc. being cast.

Conventional darts consist basically of a head and an attached tail, the head being an enlarged body of refractory material and the tail being a relatively slender, elongate member, e.g. of 1m length, with at least a portion of the tail extending below the head and being adapted to engage in the tap hole of the furnace, the head acting in effect as a float valve member and eventually closing off the tap hole as the level of the melt falls, to prevent slag exiting via the tap hole.

Conventionally, the head and tail of a dart are supplied as two separate components and are either assembled on site, or alternatively are assembled elsewhere and delivered as a single, assembled unit, although the latter arrangement creates problems with regard to packaging and transport.

In one known construction, the tail consists of a refractory concrete sleeve surrounding, and keyed to, a central reinforcing bar, the latter protruding from the upper end of the sleeve for engagement by a gripper of a lifting and lowering mechanism, and having - towards what in use is its upper end - a shoulder on which the body is adapted to be seated and there secured by air setting cement. Care must be taken to ensure that no excessive cement is used, and

furthermore, a hardwood wedge must firstly be cut and then hammered into a gap at the side of the reinforcing bar, but not to an extent that would over-stress the body and result in cracking.

In another known construction, the protruding upward end of the reinforcing bar is screw threaded, being passed through, and projecting beyond, a central hole of the head, with the latter seating on the upper end of the dart, and with the head being secured in position on the tail by a nut applied to the threaded projection.

Clearly, the above operations require a relatively skilled operator, is time consuming, and despite the care being taken in assembly, sometimes results in a damaged dart and hence the production of a scrap dart as the tail is relatively fragile, despite the presence of the reinforcing bar.

The basic object of the invention is to provide an improved dart, and an improved method of dart assembly, compared with prior art proposals.

According to a first aspect of the present invention, there is provided a metallurgical dart comprising:-

(i) an enlarged refractory head having a top, a bottom, and a central through hole extending from top to bottom of the head and lined with a metallic sleeve, with a portion of the lining sleeve projecting beyond the top and/or bottom of the head;

(ii) an elongate tail of refractory material with an external and/or internal metallic element and of external

diameter slightly less than the internal diameter of the lining sleeve, such that the tail can pass, as a close fit, through the lining sleeve of the head; and

(iii) at least one crimped or other joint between the, or a, metallic element of the tail and the projecting portion of the lining sleeve, to fix the head and tail together.

According to a second aspect of the invention of independent significance, there is provided a method of assembling a two-part metallurgical dart comprising an enlarged head having a metallic element, and an elongate tail also having a metallic element, wherein two metallic elements are brought into close proximity and a crimped or other deformed metal joint is formed between them.

Preferably, the head also has a through hole, wherein the tail is inserted through the hole of the head, or alternatively the head is passed along the tail, and thereafter the crimped or other deformed metal fixing joint is made between the two metallic elements.

The invention also includes a metallurgical dart assembled by these methods.

Thus, with the dart in accordance with the invention, a substantially simplified assembly operation is possible, resulting not only in more rapid assembly but in minimized risk of failures, with attendant cost savings. Furthermore, as the tail, or at least a portion of the tail, passes completely through the head, the latter may be fixed at a selected location along the tail most appropriate for any

particular application. Finally, the tail, if wholly or partially encased in a metallic sleeve or jacket, has considerably more strength than prior art tails, as the metallic sleeve or jacket protects the refractory during any mis-handling.

Whilst various forms of fixing joint between the metallic sleeves are possible - such as by welding or knock-in wedges - a crimped or other metal deforming joint is preferred.

Preferably, the external metallic element of the tail is an outer metallic sleeve casing the refractory material, while the refractory material of the tail may be partially or wholly encased by the sleeve.

The internal metallic element of the tail may be a central reinforcing bar embedded within the refractory material of the tail and projecting from what, in use, is an upper end of the tail. Preferably, the refractory material is monolithic, although the refractory material may be assembled from a plurality of pre-formed refractory sleeves fitted onto the central reinforcing bar or sleeve.

The projecting portion of the lining sleeve may be slightly beyond a top of the head, or slightly beyond the bottom of the head, or both above and below by the lining sleeve having a first projection portion beyond the top of the head, and a second projecting portion below the bottom of the head, so that the crimped or other joint is formed in the projecting portion of the lining sleeve beyond the top of the head, or in the projecting portion of the lining sleeve

below the bottom of the head, or wherein a first crimped or other joint is formed in the projecting portion of the lining sleeve beyond the top of the head, while a second crimped or other joint is formed in the projecting portion of the lining sleeve below the bottom of the head.

The lining sleeve may be provided with a radially extending washer or flange at its lower end engaging the head and thus serving as a supporting shelf for the head. The washer or flange may be located at the lower terminal end of the lining sleeve, or may be spaced from that end. Irrespective of its location the washer or flange is preferably secured by welding to the lining sleeve.

In another embodiment, the reinforcing bar may project from the upper end of the tail, and the crimped or other joint is formed between this projecting portion of the reinforcing bar and the portion of the lining sleeve. Preferably, the reinforcing bar projects beyond the crimped or other joint for engagement by a gripper for lifting and lowering the dart.

In one construction, both the refractory material of the tail and its external and/or internal metallic element pass through the hole of the head, while in another embodiment, the metallic element only of the tail passes through the hole of the head, which metallic element is conveniently the reinforcing bar. In this construction a terminal upper end of the refractory material of the tail may form an engaging shoulder to abut, directly or indirectly, the bottom of the head. Alternatively, a socket may be formed in the bottom of the head, a washer of the lining sleeve may be

located at the inner end of the socket, and a terminal, upper end of the refractory material of the tail may form an engaging shoulder to abut an underside of the washer.

Furthermore, the lining sleeve may be provided external with a plurality of refractory anchorages e.g. "V"-shaped elements, to assist in keying the refractory material of the head to its lining sleeve, while the lining sleeve and the metallic element(s) of the tail or preferably formed of mild steel.

Examples of dart in accordance with the first aspect of the invention, and assembled in accordance with the second aspect of the invention, will now be described in greater detail with reference to the accompanying drawings, in which;

Figure 1 is a longitudinal sectional view through a first embodiment of dart in accordance with the invention;

Figure 2 is also a longitudinal sectional view, but to a larger scale compared with Figure 1, of a second embodiment of dart;

Figure 3 corresponds to Figure 2 but shows a third embodiment; and

Figure 4 corresponds to Figure 1 but shows a fourth embodiment.

In both embodiments, like parts are accorded like reference numerals.

A metallurgical dart 1 comprises an enlarged refractory head 2 having a central through hole 3 lined with a mild steel sleeve 4. The head 2 has a top 5 above and beyond which a portion 6 of the sleeve 4 projects. The head 2 also

has a bottom 7 while the sleeve 4 terminates with an integral, radially extending washer 8 engaging the bottom 7 of the head, and serving as a support shelf for the head. Keying of the refractory head 2 to its sleeve 4 is assisted by a plurality of 'V'-shaped anchorages 9 welded externally to the sleeve 4.

A tail 10 comprises an outer mild steel sleeve 11 filled with refractory concrete 12, the sleeve 11 either extending the full length of the tail 10 as illustrated in Figure 1 or extending only part way along the length of the tail 10, with a monolithic refractory.

The sleeve 4 of the head 2 has an internal diameter D1, while the sleeve 11 of the tail 10 has an external diameter D2 slightly smaller than D1, such that the tail 10 can pass as a close sliding fit through the hole 3 of the head 2.

In accordance with the principal feature of the invention the head is secured to the tail by a crimped joint 13 between the tail sleeve 11 and the projecting portion 6 of the head sleeve 4, after the head 2 is fitted onto the tail 10 and slid along the tail 10 to the position where it is required to secure the head - which position may differ for different metallurgical applications.

Optionally, the tail 10 is provided with a central reinforcing bar 14 also of mild steel.

Figure 3 illustrates the possibilty of forming, alternatively or in addition to the one crimped joint 13 illustrated in the embodiments of figures 1 and 2, a crimped joint 13A below the bottom 7 of the head 2 by providing a

portion 6A of the sleeve for projecting below the bottom 7, while the washer 8 is secured to the lining sleeve 3 by weld metal 16.

In the embodiment of Figure 4, a socket 17 is formed in the bottom of the head 2 co-axial with the hole 3, with the washer 8 located at the upper, inner end of the socket 17, and with a terminal, upper end 18 of the refractory 12 of the tail 10 forming a shoulder to engage the underside of the washer. Furthermore, with this embodiment, the refractory 12 of the tail 10 does not pass through the hole 3, but stops at the washer 8, so that only the central reinforcing bar 14 passes through the hole 3 to form, with the portion 6 of the sleeve 4 above the top 5 of the head the crimped joint 13, with the reinforcing bar 14 extended beyond the joint 13 as a projection 15 engageable, by a gripper e.g. of a crane, for lifting the dart 1 and lowering the dart 1 into a metallurgical furnace, ladle etc., or possibly other furnace e.g. a glass making furnace.

CLAIMS

1. A metallurgical dart comprising:-

(i) an enlarged refractory head having a top, a bottom, and a central through hole extending from top to bottom of the head and lined with a metallic sleeve, with a portion of the lining sleeve projecting beyond the top and/or bottom of the head;

(ii) an elongate tail of refractory material with an external and/or internal metallic element and of external diameter slightly less than the internal diameter of the lining sleeve, such that the tail can pass, as a close fit, through the lining sleeve of the head; and

(iii) at least one crimped or other joint between the, or a, metallic element of the tail and the projecting portion of the lining sleeve, to fix the head and tail together.

2. A metallurgical dart as claimed in Claim 1, wherein the external metallic element of the tail is an outer metallic sleeve encasing the refractory material.

3. A metallurgical dart as claimed in Claim 2, wherein the refractory material of the tail is partially encased by the sleeve.

4. A metallurigical dart as claimed in Claim 2, wherein the refractory material of the tail is wholly encased by the sleeve.

5. A metallurgical dart as claimed in Claim 1, wherein the internal metallic element of the tail is a central reinforcing bar embedded within the refractory material of the

tail and projecting from what, in use, is an upper end of the tail.

6. A metallurgical dart as claimed in Claim 5, wherein the refractory material is monolithic.

7. A metallurgical dart as claimed in Claim 5, wherein the refractory material is assembled from a plurality of pre-formed refractory sleeves fitted onto the central reinforcing bar or sleeve.

8. A metallurgical dart as claimed in any preceding Claim, wherein the projecting portion of the lining sleeve is slightly beyond an upper end of the head.

9. A metallurgical dart as claimed in any one of Claims 1 to 7, wherein the projecting portion of the lining sleeve is slightly beyond a lower end of the head.

10. A metallurgical dart as claimed in any one of Claims 1 to 7, wherein the lining sleeve has a first projecting portion beyond an upper end of the head, and a second projecting portion below the lower end of the head.

11. A metallurgical dart as claimed in Claim 8, wherein the crimped or other joint is formed in the projecting portion of the lining sleeve beyond the upper end of the head.

12. A metallurgical dart as claimed in Claim 9, wherein the crimped or other joint is formed in the projecting portion of the lining sleeve below the lower end of the head.

13. A metallurgical dart as claimed in Claim 10, wherein a first crimped or other joint is formed in the projecting portion of the lining sleeve beyond the upper end of the head, while a second crimped or other joint is formed

in the projecting portion of the lining sleeve below the lower end of the head.

14. A metallurgical dart as claimed in any preceding Claim, wherein the lining sleeve is provided with a radially extending washer or flange at its lower end engaging the head and thus serving as a supporting shelf for the head.

15. A metallurgical dart as claimed in Claim 14, when appendant to Claim 11, wherein the washer or flange is located at the lower terminal end of the lining sleeeve.

16. A metallurgical dart as claimed in Claim 14, when appendant to Claim 12 or 13, wherein the washer or flange is spaced from the lower terminal end of the lining sleeve.

17. A metallurgical dart as claimed in any one of Claims 14 to 16, wherein the washer or flange is secured by welding to the lining sleeve.

18. A metallurgical dart as claimed in Claim 11 when appendant to Claim 5, wherein the reinforcing bar or tube projects from the upper end of the tail and the crimped or other joint is formed between this projecting portion of the reinforcing bar and the portion of the liner sleeve.

19. A metallurgical dart as claimed in Claim 18 wherein, the reinforcing bar projects beyond the crimped or other joint for engagement by a gripper for lifting and lowering the dart.

20. A metallurgical dart as claimed in any preceding Claim, wherein both the refractory material of the tail and its external and/or internal metallic element pass through the hole of the head.

21. A metallurgical dart as claimed in any one of Claims 1 to 19, wherein the metallic element only of the tail passes through the hole of the head.

22. A metallurgical dart as claimed in Claim 21, wherein the metallic element is the reinforcing bar.

23. A metallurgical dart as claimed in Claim 21 or 22, wherein a terminal upper end of the refractory material of the dart forms an engaging shoulder to abut, directly or indirectly, the bottom of the head.

24. A metallurgical dart as claimed in Claim 21 or Claim 22, wherein a socket is formed in the bottom of the head, a washer of the lining sleeve is located at the inner end of the socket, and a terminal, upper end of the refractory material of the dart forms an engaging shoulder to abut an underside of the washer.

25. A metallurgical dart as claimed in any preceding Claim, wherein the head sleeve is provided externally with a plurality of refractory anchorages, e.g. "V"-shaped elements, to assist in keying the refractory material of the head to its lining sleeve.

26. A metallurgical dart as claimed in any preceding Claim, wherein the lining sleeve and the metallic element(s) of the tail are formed of mild steel.

27. A method of assembling a two-part metallurgical dart as defined in any preceding claim, comprising inserting the tail through the hole of the head or alternatively passing the head along the tail, until such time as the head is located at the desired position along the tail, and crimping

or otherwise forming a fixing joint between the lining sleeve and the metallic element i.e., the external sleeve or internal bar of the tail.

28. A method of assembling a two-part metallurgical dart comprising an enlarged head having a metallic element, and an elongate tail also having a metallic element, wherein the two metallic elements are brought into close proximity and a crimped or other deformed metal joint is formed between them.

29. A method as claimed in Claim 28, wherein the head has a through hole and the tail is inserted through the hole, or alternatively the head is passed along the tail, and thereafter the crimped or other deformed metal fixing joint is made between the two metallic elements.

30. A metallurgical dart assembled by the methods of Claims 27 to 29.

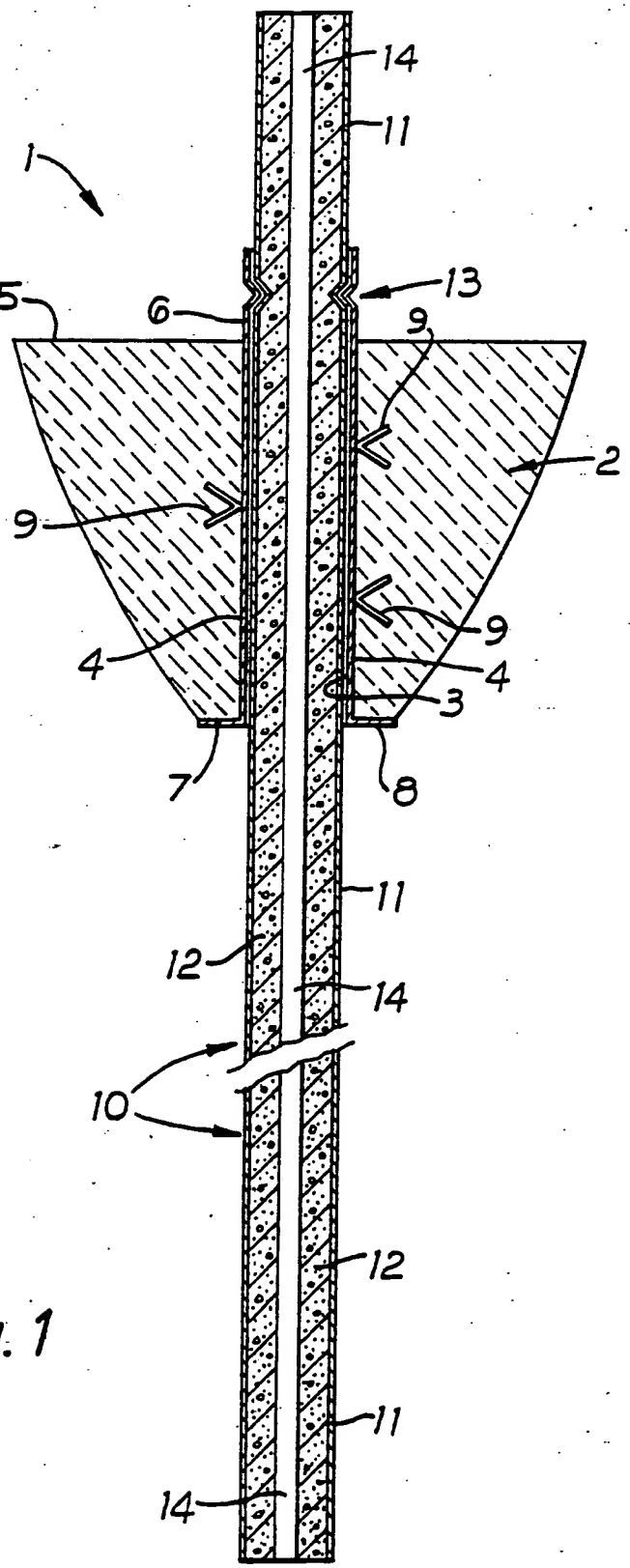

Fig. 1

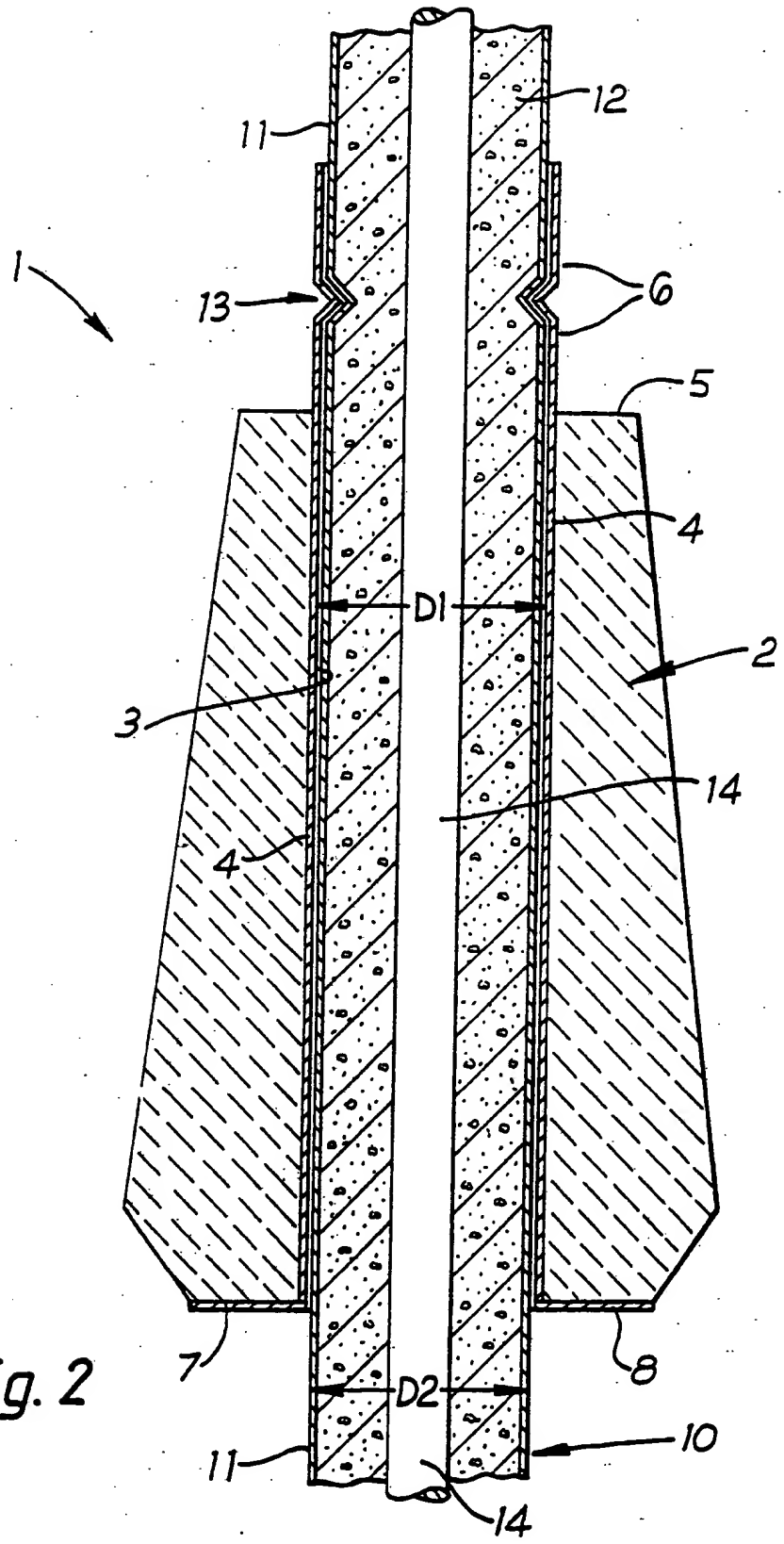

Fig. 2

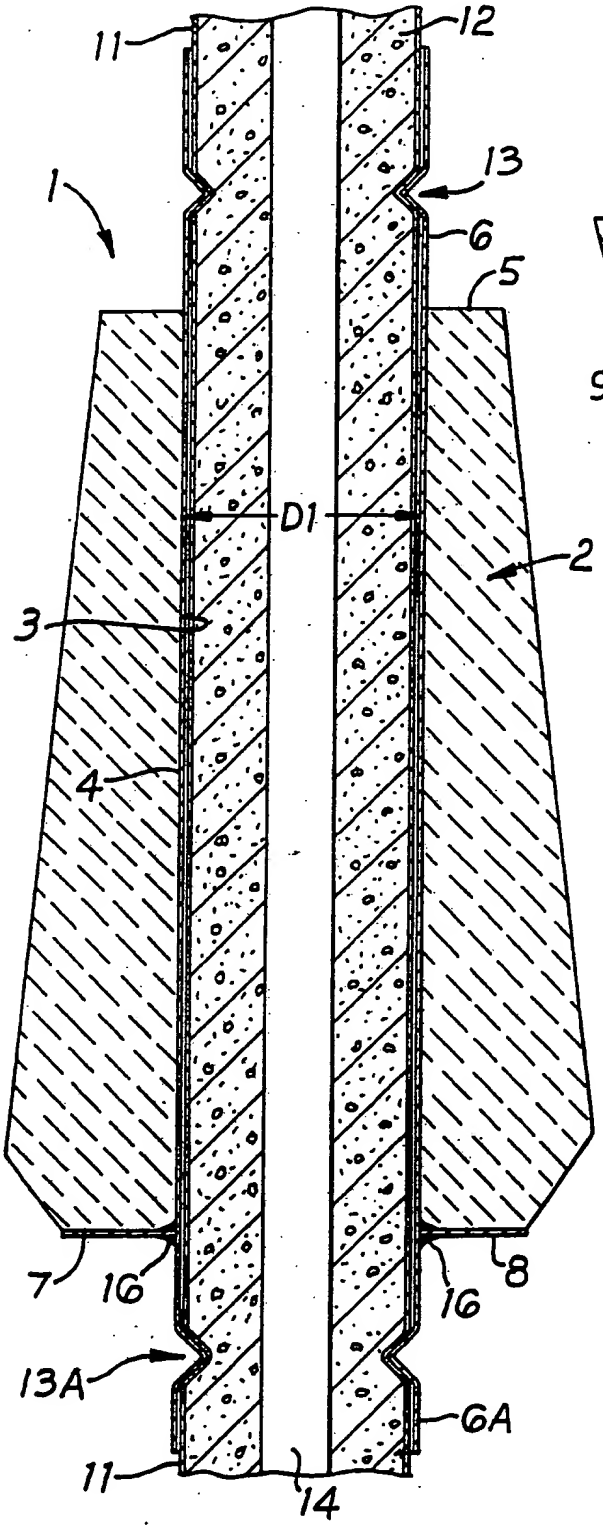
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Fig. 3

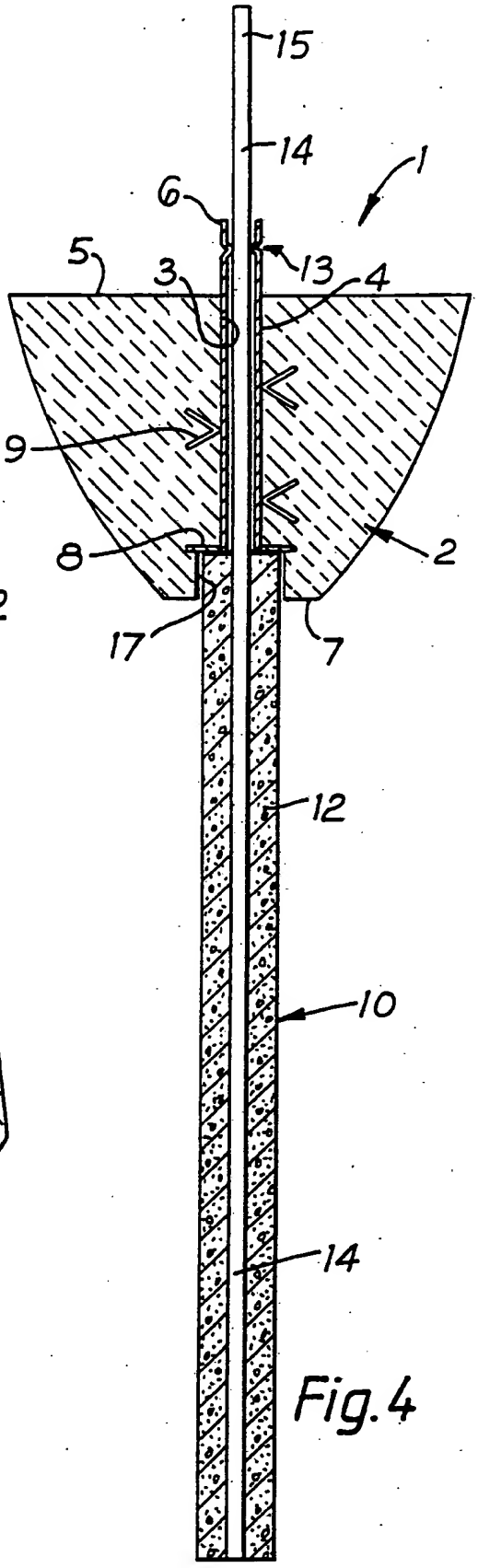
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Fig. 4

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 92/01757

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 B22D43/00; F27D3/15

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	B22D ; F27D ; C21C

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	US,A,4 799 650 (LABATE) 24 January 1989 see column 1, line 62 - column 2, line 20; figures 1-4	1,5,6,7, 11,21, 22,24, 25,29
A	DE,U,9 005 499 (FOSECO INT LTD) 12 September 1991 see page 5, line 1 - line 20; figures 1,2	1
A	GB,A,1 142 439 (MANNESMANN AG) 5 February 1969 see the whole document	1
A	US,A,4 494 734 (LABATE ET AL.) 22 January 1985 see column 2, line 8 - line 59; figures 1-3	1

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"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
03 DECEMBER 1992	30. 12. 92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	MAILLIARD A.M.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9201757 SA 64802

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 03/12/92
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4799650	24-01-89	AU-A- 8000387	23-03-89
		DE-A,C 3739038	06-04-89
		GB-A,B 2210150	01-06-89
DE-U-9005499	12-09-91	None	
GB-A-1142439		None	
US-A-4494734	22-01-85	None	